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Spider-fearful individuals hesitantly approach threat, whereas depressed individuals do not persistently approach reward

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ABSTRACT

Background and objectives: Much research documents that anxiety is related to the avoidance of threatening information. Research is also beginning to suggest that depression is related to a lack of approach toward positive information. However, many questions remain regarding the specificity and robustness of these effects. The goal of the present study was to examine specific motivational patterns differentiating between anxiety and depression.
Methods: The current study used the approach-avoidance task (AAT) to further investigate these phenomena. Spider-fearful, depressed, and non-fearful/non-depressed (control) participants pulled or pushed a joystick lever in response to positive, neutral, and negative (spider and spider-unrelated) pictures. Unlike in previous AAT studies, duration times (DTs) of joystick movements were examined in addition to reaction times (RTs).
Results: As hypothesized, in contrast to depressed and control groups, spider-fearful participants exhibited avoidance tendencies by evidencing slower RTs when pulling the joystick in response to spider versus neutral pictures. As further hypothesized, depressed participants exhibited diminished approach motivation as evidenced by their pulling positive pictures for a shorter duration than neutral pictures, in comparison to the control group.
Limitations: Participants in our study were from a non-clinical student sample and further research is required for generalization to spider phobia and major depressive disorder.
Conclusion: These findings inform theoretical understanding of the specific motivational tendencies of anxiety and depression, and introduce a modification of the AAT that, if incorporated in clinical settings, would increase the specificity and success of cognitive bias modifications.

1. Introduction

Anxiety and depressive disorders are the most common forms of psychopathology (Kessler, Chiu, & Demler, 2005). Depressive disorders are particularly difficult to treat, as evidenced by limited symptom remission to empirically supported treatments (e.g., Dimidjian et al., 2006) and high risk of relapse (e.g., Scott et al., 2000). The high rates of comorbidity of anxiety and depression symptoms (Kessler et al., 2005) may be one factor hindering conceptualization and thus successful treatments. Therefore, unraveling the core, non-overlapping features of each disorder is key.

One way to distinguish core features may be through examining differences in approach-avoidance motivational tendencies (e.g., Davidson, 1993). Extant models suggest that a unique motivational aspect of anxiety may be *heightened avoidance of negative information*,[1] whereas a unique motivational aspect of depression may be *diminished approach of rewarding information* (e.g., Davidson, 1998; Dickson, 2006; Henriques & Davidson, 2000; Kashdan, Elhai, & Breen, 2008). However, empirical research has yet to elucidate how these differential motivational tendencies specifically unfold over time.

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[1] Although research indicates that anxious individuals initially attend to threatening information, studies also support the vigilance-avoidance hypothesis, which suggest that these individuals ultimately avoid threatening information (e.g., Cooper & Langton, 2006; Mogg, Bradley, Miles, & Dixon, 2004).

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1.1. Assessing motivational tendencies using the approach-avoidance task

Over half a century ago, Solarz (1960) demonstrated that people display faster arm movements toward themselves than away from themselves when viewing positive stimuli, and that the opposite pattern emerges when viewing negative stimuli. More recent findings suggest that arm movement indicates approach and avoidance tendencies; specifically, arm extension (pushing motion) reflects or activates an avoidance tendency and arm flexion (pulling motion) reflects or activates an approach tendency (Cacioppo, Priester, & Berntson, 1993).

The approach-avoidance task (AAT) is a paradigm used to investigate motivational tendencies. In the AAT, participants are instructed to pull or push a joystick lever as quickly as possible in response to pictures. The AAT is an indirect task because participants do not respond to the content of the pictures but rather to content-irrelevant aspects such as a picture orientation or color of a surrounding frame. An avoidance tendency is inferred when participants push the joystick lever faster than they pull it, whereas an approach tendency is inferred when participants pull the joystick faster than they push it.

In AAT studies, anxious/fearful people commonly demonstrate avoidance in response to threatening pictures, whereas they demonstrate no approach-avoidance tendencies for neutral pictures. In comparison, non-anxious/non-fearful individuals usually do not evidence differential responses due to picture type (Heuer, Rinck, & Becker, 2007; Rinck & Becker, 2007; Roelofs et al., 2010; but see Lange, Keijsers, Becker, & Rinck, 2008). Depression has also been investigated with the AAT in one study in which a clear pattern of findings did not emerge (Seidel et al., 2010). However, due to task limitations discussed below, the version of the AAT used in that study may not have yielded relevant information about depressed individuals' approach tendencies.

1.2. Initial modification of the approach-avoidance task

The AAT usually only measures difference scores between reaction times (RTs) of pushing versus pulling a particular picture type, such that negative RT scores indicate avoidance motivation and positive RT scores indicate approach motivation (e.g., Rinck & Becker, 2007; Roelofs et al., 2010). Unfortunately, the use of difference scores leads to ambiguity of data interpretation because negative scores may result from faster arm extension (pushing), slower arm flexion (pulling), or both. Moreover, as argued by Najmi, Kuckertz, and Amir (2010), faster arm extension and slower arm flexion may correspond to different aspects of avoidance. Specifically, pushing away (i.e., removing) a dangerous object may be associated with reduction in fear/anxiety and thus with negative reinforcement, whereas pulling a dangerous object may be related to increase in negative emotions and thus punishment.

To overcome this limitation, Najmi et al. (2010) compared RTs in response to threatening versus neutral pictures *separately* for each movement direction (i.e., pushing and pulling). That is, RTs of pulling threatening pictures were compared not to RTs of pushing threatening pictures but rather to RTs of pulling neutral pictures. This important change in scoring allows for examining each movement direction independently of one another.

1.3. A further modification of the AAT: assessment of duration times

Despite Najmi et al.'s (2010) improvement, the AAT may have another previously unaddressed limitation. Reaction times seem to capture avoidance tendencies, but they may not be appropriate for assessment of approach tendencies. Faster movement may be indicative of avoidance when immediate threat is present because the speed of avoidance of dangerous stimuli (e.g., venomous spiders) may have survival value. However, rewarding stimuli may be more likely to result in persistence rather than fast and short-lasting reactions. Indeed, motivational findings suggest that when people find something rewarding, they persist longer (e.g., Deci & Ryan, 1985). Moreover, the motivation to savor reward may be an important buffer against depressed states (Gilbert, 2012; McMakin, Siegle, & Shirk, 2011).

Thus, although avoidance may be measured by RTs of arm movement, approach could be more properly measured by *duration times* (DTs) of arm movement; that is, higher (or lower) levels of approach motivations should correspond to more (or less) *sustained* arm flexion. Importantly, the use of duration and reaction times would therefore allow for independent assessment of approach and avoidance motivation.

1.4. The present study

The present study examined approach and avoidance tendencies in spider-fearful, depressed, and control groups via the modified AAT. Consistent with previous studies, we hypothesized that, unlike depressed and control groups, spider-fearful participants would exhibit avoidance of spider pictures by faster pushing and/or slower pulling of such pictures than neutral pictures. As in previous research, this tendency was examined via the zooming AAT, in which (1) pulling or pushing the joystick lever increases or decreases, respectively, the size of a picture displayed on a screen and (2) reaction times are the outcome variable (cf. Heuer et al., 2007; Najmi et al., 2010; Rinck & Becker, 2007). We also hypothesized that, consistent with previous research (e.g., Davidson, 1998; Dickson, 2006; Kashdan et al., 2008) *but novel to research using the AAT*, depressed individuals would display diminished approach motivation as evidenced by shorter duration times (DTs) (i.e., sustained time spent) pulling positive as opposed to neutral pictures, in comparison to spider-fearful and control groups.

2. Methods

2.1. Participants

At the beginning of the semester, students in an Introductory Psychology class at a Midwestern university initially completed the Beck Depression Inventory II (BDI-II) and two 5-point items of the Interview for Mood and Anxiety Symptoms (IMAS) assessing fear and avoidance of spiders. The reports of depressive symptoms and fear of spiders were later reassessed with the BDI-II and the Fear of Spider Questionnaire (FSQ; all scales described below), and three groups were preselected: (1) a control group (IMAS $\leq$ 3, FSQ < 50, and both initial and reassessment BDI-II $\leq$ 13), (2) a spider-fearful group (IMAS = 10, FSQ $\geq$ 70, and initial BDI-II < 20), and (3) a depressed group (IMAS < 10, and both initial and reassessment BDI-II $\geq$ 20). Table 1 presents self-report symptom information for each group. Students (N = 120; 65% women; M_{age} = 19.22, SD = 2.72) meeting the pre-selection criteria participated in exchange for partial course credit. The sample consisted of 29

Table 1
Means (and standard deviations) of self-reported depressive and spider phobia symptoms as a function of group.

Measure	Group		
	Control (n = 47)	Spider-fearful (n = 50)	Depressed (n = 23)
BDI-II	4.70 (3.38)	11.22 (10.33)	29.04 (6.87)
FSQ	11.30 (13.12)	102.52 (15.83)	44.22 (35.59)

Note. Underlined means are above the clinical cutoff scores. BDI-II = Beck Depression Inventory-II; FSQ = Fear of Spiders Questionnaire.

Caucasians, 10 African Americans, 35 Asian Americans, 43 Hispanics, and 3 individuals who identified as "other" (e.g., multiracial).

2.2. Materials and tasks

2.2.1. Self-report measures

Depressive symptoms were assessed using the Beck Depression Inventory II (BDI-II; Beck, Steer, & Brown, 1996). The BDI-II is the most commonly used self-report measure of emotional (e.g., loss of pleasure), cognitive (e.g., concentration), and physical (e.g., tiredness) symptoms of depression including suicidal thoughts. It has excellent psychometric properties (Beck et al., 1996) and consists of 21 items, each answered on a 4-point Likert scale with higher scores indicating more severe levels of depression.

During pre-selection, participants completed two items of the Interview for Mood and Anxiety Symptoms (IMAS; Gamez, Kotov, & Watson, 2010) assessing fear ("Do you strongly fear or find it uncomfortable …") and avoidance ("Would you avoid it if at all possible …") of spiders ("… when faced with insects such as spiders?") on a 5-point Likert scale from *Not at all* to *Extremely*. To verify these responses, participants completed the 18-item Fear of Spiders Questionnaire (FSQ; Szymanski & O'Donohue, 1995) during the experimental session by indicating how much they agreed with each statement using an 8-point scale from 0 (*Totally Disagree*) to 7 (*Totally Agree*). The FSQ has excellent internal consistency (Cronbach's alpha .92) and good convergent validity, and it is sensitive to differences between spider-fearful participants and non-phobics.

2.2.2. The approach-avoidance tasks (AAT)

The AAT comprised pictures from the International Affective Picture System (IAPS) – a standardized database of over 700 pictures. The pictures were selected based on the valence and arousal ratings (provided in the IAPS manual – Lang, Bradley, & Cuthbert, 2008). Practice trials included five positive ($M = 7.41$, $SD = .66$) and five negative ($M = 3.19$, $SD = .55$) pictures with relatively low ratings of arousal ($M = 3.91$, $SD = .22$). Actual trials featured three sets of 14 pictures from different valence categories[2]: positive ($M = 7.53$, $SD = .42$), neutral ($M = 4.95$, $SD = .23$), and negative ($M = 2.53$, $SD = .83$) with similar ratings of arousal for the positive ($M = 6.05$, $SD = .52$) and negative ($M = 6.28$, $SD = .84$) pictures; half of the negative pictures presented spiders.

During both the practice and actual trials, each picture was presented twice, once with a blue and once with a yellow oval frame embedded in it; all pictures were randomly presented on a 19-inch computer screen with a resolution of 1024 × 768 pixels. A participant responded to the color of the frame regardless of the picture content using a joystick (Logitech Attack 3; cf. Lange et al., 2008; Roelofs et al., 2010) permanently positioned on the table in front of the monitor. Half of the participants were instructed to pull the joystick in response to a blue frame and push it in response to a yellow frame (pull-blue/push-yellow) and the other half were given the opposite instructions (pull-yellow/push-blue); participants were also instructed to respond with the joystick as fast as possible.

All participants first completed 20 practice trials to familiarize themselves with the procedure. During the practice, whenever the participant moved the joystick lever in the wrong direction (e.g., pushing instead of pulling), a warning ("INCORRECT!") in red color would be displayed in the center of the screen for 1000 ms. During the 84 actual trials of both versions of the AAT (described below), participants responded to a new set of pictures, but no warning was displayed in case of an incorrect joystick movement. Additionally, after trials 28 and 56, an onscreen message informed participants to press the joystick button in order to start the next trial; this allowed participants to pause for a while in order to reduce fatigue and/or inattentiveness.

2.2.2.1. Zooming AAT. Each trial of the Zooming (i.e., standard) AAT was comprised of a fixation cross (2000 ms) followed by a picture that was initially displayed in medium size (432 × 324 pixels). Pulling or pushing the joystick lever increased or decreased, respectively, the size of the picture on the screen creating an illusion of zooming. As in prior research (e.g., Lange et al., 2008), to allow for the zooming effect, each picture was made in seven different sizes ranging from 137 × 103 to 1024 × 768. After pulling the joystick lever, the initial picture increased in size until it filled the entire screen (1024 × 768) and ultimately disappeared. This created the illusion that the picture moved toward the participant. Alternatively, after pushing the joystick lever, the initial picture decreased in size and then disappeared creating an illusion of the picture moving away from the participant. After each trial, the fixation cross was displayed for 2000 ms followed by another picture, with all 42 pictures displayed twice (84 trials).

2.2.2.2. AAT duration times (AAT-DT). Measurement of duration times (DTs) using the standard zooming AAT could be problematic because once a participant responds with the joystick lever, a picture changes in size and disappears. This dynamic nature of the task could have confounding effects on the duration times and make interpretations regarding approach motivation difficult. In other words, in the zooming AAT, participants may return the joystick lever to its resting position not because they are less motivated to respond to a stimulus but because the stimulus is no longer present on the screen. We thus developed a new version of the AAT to measure duration times (i.e., the AAT-DT) such that each picture (1) was displayed in one size (1024 × 768) and (2) remained onscreen for 2000 ms, regardless of participant response. Thus a single trial was comprised of a fixation cross (2000 ms) followed by a 1024 × 768 picture (2000 ms); the picture was then automatically replaced by a fixation cross followed by another picture – the cycle was repeated until all 42 pictures were displayed twice (84 trials).

In the AAT-DT developed for the present study, duration times (DTs) can be captured because the position of the joystick lever is recorded every 10 ms. DTs are defined as the amount of time the joystick lever is pulled or pushed 80 percent or more from its middle (resting) position in the correct direction in response to a picture. Of note is that because DT data are collected only while a picture appears on the screen, participants who continue pushing/pulling the joystick after a picture disappears do not produce usable data. In the present study, DT data were not available for 15 participants (6 controls, 4 spider-fearful, and 5 depressed) who were not overly representative of any one group, $\chi^2\,(2) = 2.72$, $p = .26$, and who did not differ from the rest of the sample on BDI-II $t(118) = .95$, $p = .35$, or FSQ scores, $t(118) = 1.28$, $p = .21$.

2.3. Procedures

Once participants arrived at the laboratory, the experimenter provided an overview of the study and explained the AAT task. Specifically, the experimenter informed participants that they would see images on the screen and that some images may present negative content such as mutilated bodies or spiders. Participants were further asked to respond to images by either pulling or pushing the

[2] Negative pictures included: 1200, 1201, 1220, 3015, 3120, 3140, 6230, 6242, 6350, 6510 with an additional four pictures of spiders found online; neutral pictures included: 7000, 7002, 7004, 7009, 7010, 7025, 7090, 7150, 7175, 7186, 7205, 7233, 7235, 7705; positive pictures included: 1710, 2216, 4608, 4659, 4670, 7230, 7270, 7330, 7502, 8190, 8490, 8496, 8501, 8502.

joystick lever in the correct direction "as quickly and as accurately as possible." In addition, only for the AAT-DT, the experimenter also instructed the participants to imagine a "picture increasing in size and getting closer" when they pulled the joystick lever toward themselves and to imagine a "picture decreasing in size and moving further away" when they pushed the joystick away from themselves.

After an informed consent procedure, the experimenter moved to a different location, and participants began the tasks which were presented and timed using *MediaLab/DirectRT* (Jarvis, 2004) software. Participants first completed the practice trials, then the AAT-DT, and then the standard Zooming AAT. Next, participants provided valence ratings of all pictures on a 9-point scale (1 = *Very Unpleasant* to 9 = *Very Pleasant*). They then completed the BDI-II and FSQ, and provided demographic information. All participants were debriefed at the end of the study.

2.4. Design

The instruction variable (i.e., pull-blue/push-yellow versus pull-yellow/push-blue) did not interact with any other variable; consequently, data were collapsed across the two instruction groups. Reaction times as well as duration times of pushing and pulling the joystick lever were submitted to separate 3 (Group: controls, spider-fearful, depressed) × 2 (Picture Type: neutral, valenced [spider, negative/non-spider, or positive]) mixed analyses of variance (ANOVAs) with group as a between-subject variable and picture type as a within-subject variable.

3. Results

3.1. Explicit picture ratings

Before analyzing the AAT effects, one-way ANOVAs explored group differences in explicit valence ratings of pictures (see Table 2). The results indicated that the groups did not differ in ratings of neutral, $F(2, 117) = 2.21$, $p = .11$, $\eta_p^2 = .04$, or positive pictures, $F(2, 117) = .81$, $p = .45$, $\eta_p^2 = .01$, and only marginally differed in ratings of spider-unrelated negative pictures, $F(2, 117) = 2.53$, $p = .084$, $\eta_p^2 = .04$. However, the groups differed in ratings of spider pictures, $F(2, 117) = 66.40$, $p < .001$, $\eta_p^2 = .53$. Planned contrasts revealed that compared to the control group, the spider-fearful group, $t(117) = 3.38$, $p < .001$, and the depressed group, $t(117) = 2.26$, $p = .026$, rated the spider pictures as more unpleasant. In addition, an LSD post-hoc comparison revealed that spider-fearful individuals rated the spider images as more unpleasant than did the depressed participants, $t(117) = 6.78$, $p < .001$).

3.2. Zooming AAT: reaction times

Similar to previous research (e.g., Najmi et al., 2010; Rinck & Becker, 2007; Roelofs et al., 2010), all incorrect joystick responses (2.7%) as well as reaction times (RTs) below 100 ms and above 1500 ms (.91%) were removed from analyses.

Table 2
Means (and standard deviations) of explicit picture ratings as a function of group and picture type.

Picture type	Group		
	Control ($n = 47$)	Spider-fearful ($n = 50$)	Depressed ($n = 23$)
Neutral	5.23 (.36)	5.20 (.60)	5.47 (.58)
Positive	7.55 (.86)	7.61 (.95)	7.32 (1.01)
Negative/non-spider	1.76 (.79)	1.44 (.61)	1.61 (.75)
Negative/spider	3.43 (1.11)	**1.23** (.51)	2.88 (1.33)

Note. Means in bold indicate explicit ratings of pictures by a particular group that differ significantly ($p < .05$) from ratings of the same pictures by the other groups. BDI-II = Beck Depression Inventory-II; FSQ = Fear of Spiders Questionnaire.

3.2.1. Negative/spider pictures versus neutral pictures

RTs of *pulling* spider and neutral pictures are displayed in Fig. 1. Results indicated significant main effects of Group, $F(2, 117) = 7.74$, $p < .001$, $\eta_p^2 = .12$, and Picture Type, $F(1, 117) = 14.15$, $p < .001$, $\eta_p^2 = .11$. The main effects were qualified by a significant Group × Picture Type interaction, $F(2, 117) = 3.52$, $p = .033$, $\eta_p^2 = .06$. Planned contrasts indicated that spider-fearful participants were slower to pull spider pictures than neutral pictures in comparison to controls, $t(117) = 2.41$, $p = .018$, who in turn did not differ from depressed participants, $t(117) = .02$, $p = .981$. To explore all group differences, an LSD post-hoc analysis also revealed that spider-fearful individuals tended to pull spider pictures more slowly than neutral ones compared to the depressed participants, $t(117) = 1.97$, $p = .052$. Consistent with these results, there was a positive correlation between FSQ scores and RTs of pulling spider (versus neutral) pictures, $r(118) = .24$, $p = .008$.

There was also main effects of Group, $F(2, 117) = 6.77$, $p = .002$, $\eta_p^2 = .10$, and Picture Type, $F(1, 117) = 7.17$, $p = .008$, $\eta_p^2 = .058$, on the RTs of *pushing* spider and neutral pictures. However, the interaction was not significant $F(2, 117) = 1.01$, $p = .37$, $\eta_p^2 = .02$.

3.2.2. Negative/non-spider pictures versus neutral pictures

RTs of *pulling* negative/non-spider and neutral pictures differed as a function of Group, $F(2, 117) = 6.33$, $p = .002$, $\eta_p^2 = .10$, and Picture Type, $F(1, 117) = 23.20$, $p < .001$, $\eta_p^2 = .17$. However, the Group × Picture Type interaction was not significant, $F(2, 117) = .51$, $p = .60$, $\eta_p^2 = .01$. In regards to RTs of *pushing* negative/non-spider and neutral pictures, results again revealed main effects of Group, $F(2, 117) = 6.53$, $p = .002$, $\eta_p^2 = .10$, and Picture Type, $F(1, 117) = 8.97$, $p = .003$, $\eta_p^2 = .07$, and a non-significant interaction, $F(2, 117) = 1.64$, $p = .20$, $\eta_p^2 = .03$.

3.2.3. Positive pictures versus neutral pictures

An ANOVA examining the RTs of *pulling* positive and neutral pictures indicated significant main effects of Group, $F(2, 117) = 5.59$, $p = .005$, $\eta_p^2 = .09$, and Picture Type, $F(1, 117) = 19.53$, $p < .001$, $\eta_p^2 = .14$. Yet, the interaction remained non-significant, $F(2, 117) = 1.56$, $p = .22$, $\eta_p^2 = .03$. Similarly, results revealed main effects

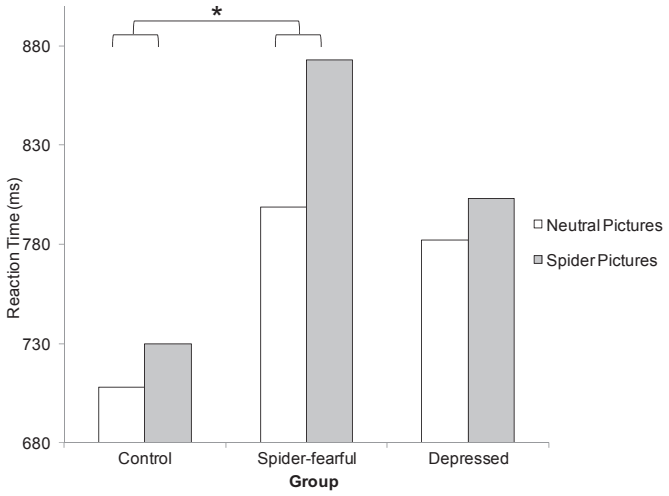

Fig. 1. Reaction times (RTs) of pulling the joystick lever as a function of group and picture type. Spider-fearful participants were slower to pull the joystick in response to spider pictures than to neutral pictures, differing from depressed or control participants. *$p < .05$.

of Group, $F(2, 117) = 5.46$, $p = .005$, $\eta_p^2 = .09$, and Picture Type, $F(1, 117) = 14.83$, $p < .001$, $\eta_p^2 = .11$, on RTs of *pushing* neutral and positive pictures, but the interaction was non-significant, $F(2, 117) = .03$, $p = .97$, $\eta_p^2 = .00$.

3.3. AAT duration times (AAT-DT)

Incorrect joystick responses (1.8%) were removed from analyses. In addition, data from 374 of the (105 × 84=) 8820 (4.2%) trials were missing due to participants' pulling/pushing the joystick lever after a picture disappeared from the screen.

3.3.1. Negative/spider pictures versus neutral pictures

An ANOVA examining DTs of *pulling* spider and neutral pictures yielded neither significant main effects (*ps* > .25) nor a significant interaction ($p > .77$). A second ANOVA showed a main effect of Picture Type, $F(1, 102) = 5.15$, $p = .025$, $\eta_p^2 = .05$, on DTs of *pushing* spider and neutral pictures. No other results were significant (*ps* > .29).

3.3.2. Negative/non-spider pictures versus neutral pictures

In regards to DTs of *pulling* negative/non-spider and neutral pictures, results showed a non-significant main effect of Group, $F(2, 102) = 1.43$, $p = .24$, $\eta_p^2 = .03$, and a main effect of Picture Type, $F(1, 102) = 8.07$, $p = .005$, $\eta_p^2 = .07$. The interaction was non-significant, $F(2, 102) = .86$, $p = .43$, $\eta_p^2 = .02$. DTs of *pushing* negative/non-spider and neutral pictures displayed a similar pattern with a non-significant main effect of Group, $F(2, 102) = 1.50$, $p = .23$, $\eta_p^2 = .03$, a main effect of Picture Type, $F(1, 102) = 13.75$, $p < .001$, $\eta_p^2 = .12$, and a non-significant interaction, $F(2, 102) = 1.41$, $p = .25$, $\eta_p^2 = .03$.

3.3.3. Positive pictures versus neutral pictures

Fig. 2 displays the DTs of *pulling* positive and neutral pictures. The main effects of Group, $F(2, 102) = 1.06$, $p = .35$, $\eta_p^2 = .02$, and Picture Type, $F(1, 102) = .01$, $p = .94$, $\eta_p^2 = .00$, were non-significant. However, the main effects were qualified by a significant interaction, $F(2, 102) = 3.67$, $p = .029$, $\eta_p^2 = .07$. Planned contrasts revealed that control participants pulled positive pictures longer than neutral pictures, which did not significantly differ from the pattern evidenced by spider-fearful participants, $t(102) = 1.64$, $p = .10$. However, the depressed group pulled positive pictures for a *shorter* amount of time than neutral pictures in comparison to the control group, $t(102) = 2.63$, $p = .010$. An LSD post-hoc test showed that the difference between spider-fearful and depressed groups in DTs of pulling positive and neutral pictures did not reach significance, $t(102) = 1.41$, $p = .16$. Correlational analyses provided further support for our hypothesis in that depression scores were negatively associated with duration times of pulling the joystick in response to positive (versus neutral) pictures, $r(103) = -.21$, $p = .035$. Thus, depressed individuals exhibited less approach motivation to positive than to neutral stimuli. No significant results were found for DTs of *pushing* positive and neutral pictures (*ps* > .13).

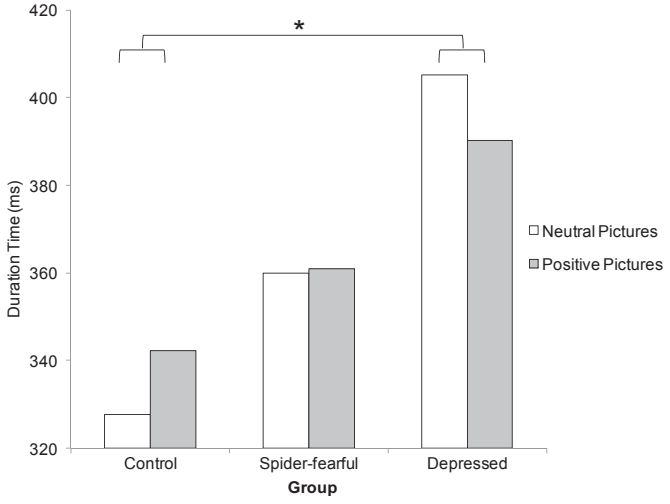

Fig. 2. Duration times (DTs) of pulling the joystick lever as a function of group and picture type. Depressed participants pulled positive pictures for less time than neutral pictures in comparison to controls, who, in turn, did not differ from spider-fearful participants. *$p < .05$.

4. Discussion

4.1. Reaction times

Spider-fearful individuals were slower at *pulling* spider pictures than neutral pictures but pulled non-spider (positive or negative) and neutral pictures equally fast. This difference also correlated positively with explicit self-reports of fear of spiders. For the control and depressed groups, RTs of pulling the joystick lever did not differ as a function of the picture type, and RTs of *pushing* the joystick lever did not differ in any of the groups regardless of the picture type.

These findings closely mirror those obtained by Najmi et al. (2010), in which contamination-fearful individuals were slower to pull the joystick lever in response to contamination-related pictures than in response to neutral pictures but did not display different motivational patterns while pushing in response to pictures. In addition, the present findings expand upon those efforts in two important ways. First, depressed individuals were included along with fearful and control participants. Second, besides neutral and spider pictures, the current study also contained positive and spider-unrelated negative pictures. These additions allowed for further examination of psychopathology-specific motivational tendencies.

Previous studies (with the exception of the study by Najmi et al., 2010) examined AAT effects by subtracting RTs of pulling from RTs of pushing the joystick. As explained in the introduction, such computation of scores may result in interpretability issues. Indeed, both this study and that conducted by Najmi et al. (2010) indicated that it is slower pulling, rather than faster pushing, of fear-inducing objects that is responsible for AAT effects. In other words, both spider-fearful and contamination-fearful individuals seem motivated to avoid negative stimuli by staying away from them rather than by removing them.

One possibility for these differential effects may be associated with the AAT methodology. Specifically, it is conceivable that instructions to respond as quickly as possible lead to a floor effect such that participant may be responding so quickly that when fear-inducing stimuli are presented, reaction times cannot be any faster. If this is the case, then the only opportunity for variability would involve slowing down one's movement (e.g., arm flexion). Another possibility may involve the fact that removing a dangerous object often requires initial reduction in physical distance between oneself and the object. In the AAT, participants are asked to push the joystick lever, and thus the image (e.g., spider), away from them. It is possible that participants imagine coming in contact with the spider in order to push it away. Although the final outcome of this reaction would lead to reduction in anxiety or fear (negative reinforcement), initially it leads to an increase of these emotions (punishment). Consequently, when asked to push away a spider, spider-fearful individuals may vacillate and not exhibit faster reaction times.

4.2. Duration times

Beyond the RT findings, this is a first study that examined duration times (DTs) in the AAT. This modification yielded novel but anticipated finding that depressed individuals *pulled* the positive pictures for a shorter amount of time than neutral pictures compared to control participants. Moreover, the difference scores between DTs of pulling positive and neutral pictures were negatively correlated with self-reports of depression (i.e., BDI scores). These findings indicate diminished approach motivation in the presence of positive stimuli in depressed people and are uniquely specific for two reasons. First, they were specific to the depressed group because neither the spider-fearful nor control participants exhibited such tendencies. Second, they were specific to pulling positive pictures; there were no differences in duration times of pulling neutral as opposed to either type of negative pictures (in any of the groups) and DTs of *pushing* the joystick lever were not affected by either the group or the picture type.

The finding of a lack of sustained approach toward positive information provides support for theories that posit a lack of savoring positive affect as leading to and maintaining depressed states (Gilbert, 2012; McMakin et al., 2011). Moreover, the finding that depressed individuals were *less likely to continue to approach positive stimuli than neutral stimuli* provides support for theories positing not only a lack of valuation of positive information by depressed individuals, but a potential *devaluation* of reward that is leading to and maintaining depressed states (Frewen, Dozois, Joanisse, & Neufeld, 2008).

4.3. Implications for the training AAT

Recently, a training version of the task has also been used to modify automatic approach-avoidance tendencies and to change consequent behaviors (Amir, Kuckertz, & Najmi, 2013; Taylor & Amir, 2012; Wiers, Rinck, Kordts, Houben, & Strack, 2010). This training involves participants pulling most pictures of one type and pushing most pictures of another type.

To date, the training AAT has been successfully used to decrease drinking tendency in hazardous drinkers (Wiers et al., 2010), increase social approach behaviors (e.g., friendliness, engagement in conversation) in socially anxious individuals (Taylor & Amir, 2012), and increase willingness to touch and handle “contaminated” objects (e.g., dead insects, dirty toilet) by contamination-fearful participants (Amir et al., 2013). However, our findings indicate that the training AAT would be unlikely to increase approach motivation toward rewarding stimuli in depressed individuals because, like the assessment AAT, the training AAT is incapable of separating approach and avoidance tendencies. To affect approach tendencies, the training AAT has to additionally manipulate *duration times* of pulling target pictures. Specifically, such a modified version of the training AAT would require depressed participants to pull most positive pictures for a longer time than neutral (or negative) pictures (while keeping the exposure time to all pictures constant). Consistent with behavioral activation protocols (Mazzucchelli, Kane, & Rees, 2009), such manipulation of automatic approach tendencies toward positive stimuli may change the consequent overt behaviors toward the same stimuli. In response to recent calls for refined bias modification paradigms (e.g., Rapee et al., 2013), the methodological advance of examining duration times introduced here now allows for future exploration of this possibility.

4.4. Limitations and future studies

The current study included groups with different levels of clinical symptomatology based on participants' self-reports. Future studies should replicate the findings using samples screened with clinician-administered scales. Due to the high level of comorbidity between anxiety and depression, less stringent exclusion criteria were chosen for the spider-fearful group (i.e., higher BDI-II cut-off score) and the depressed group (i.e., higher IMAS cut-off score) compared to the control group. This resulted in symptom overlap between the spider-fearful and depressed groups such that both groups were more elevated in both anxiety and depression symptoms than controls. This overlap may thus account for the lack of difference on the AAT-DT between the two analog groups. Furthermore, multiple studies with larger samples of depressed individuals should further explore the relationship between AAT duration times (AAT-DT) and depressive symptoms. As with following-up any novel paradigm and set of findings, it will be important to examine optimal parameters of the AAT-DT such as selection of positive pictures, picture presentation time, and instructions, among other considerations. For example, future studies could increase the window of presentation of pictures to allow for graded investigations of duration times, or investigate whether the AAT-DT is related to symptoms other than those of depression.

4.5. Conclusion

Despite these limitations, this study is the first to compare joystick responses of three groups of people (controls, spider-fearful, and depressed) to four types of images (positive, neutral, and spider-related and spider-unrelated negative). Moreover, this was also the first study that examined not only reaction times *but also duration times* of joystick movements. Consequently, the study's innovative design allowed for a novel array of findings to emerge. First, heightened avoidance motivational tendencies of spider-fearful participants were captured by their *reaction times* to spider pictures. Second, diminished approach motivational tendencies of depressed individuals were indexed by their *duration times* in response to positive pictures. The second finding can lead to clinical translations that are aimed at increasing duration times to positive pictures and thus are more likely to impact depressive symptomatology.

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